2010

The KCMO stream setback ordinance: Science, public involvement, and water quality protection

Laurie Lynn Brown
Iowa State University

The KCMO setback ordinance:
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by

Laurie Lynn Brown

A thesis submitted to the graduate faculty

In partial fulfillment of the requirements for the degree of

MASTER OF COMMUNITY AND REGIONAL PLANNING

Major: Community and Regional Planning

Program of Study Committee:
Tara L. Clapp (Major Professor)
Timothy O. Borich
Richard C. Schultz

Iowa State University

Ames, Iowa

2010

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Chapter 1 Introduction

> *"We believe that in order for a natural resource policy to make sense and to work in the real world, it must be rooted in the people on the land. It must be nurtured by debate, education, cultural experience, science and technology, and good communication."* (Lyons, 1997)

Cities represent unique ecosystems within which humans play a significant role. The ecology of urban areas is similar to that of rural areas with the exception of the greater role played by humans in the system. Like the plants and animals associated with ecosystems, humans have an impact on and are in turn impacted by the environment surrounding them. Social and ecological studies of cities as ecosystems have generally been mutually exclusive of each other. However, current thinking is changing as both biological and social scientists have begun to examine the two together, realizing there is much to learn from their integration (Alberti, 2008; Wagner and Gobster, 2007). It is hoped that as research into urban ecosystems grows, people will gain a better understanding of how to balance the needs of man and nature.

Protection of natural resources within urban ecosystems has taken a back seat to economic development for most communities. Yet, those who have integrated these resources into their plans and developments have found they have healthier, more stable and more desirable communities. Growth or progress and protection of natural resources do not have to be mutually exclusive goals. A prime example is in the case of water quality protection. In the past, development within communities was limited by topography and the presence of certain resources. Over time, technology has provided a means for overcoming these obstacles. Developments are no longer kept away from streams, wetlands, or steep slopes. People have used technology to drain wetlands, fill in streams, and cut down hillsides. What we have been slow to learn is that our arrogance in the use of technology to overcome nature has a price (Stanley, 1995). Now we are faced with stormwater runoff that increases flooding, damages infrastructure, decreases water quality, degrades aquatic and terrestrial ecosystems, and increases the introduction of invasive species. Our streams, which used to perform valuable functions in controlling stormwater runoff and filtering pollutants, now simply carry these problems with greater volume and velocity to our neighbors downstream.

The desire to conserve natural resources conflicts with another long-term tradition of emphasizing individual and corporate freedom to optimize short-term profits (Andrews, 1999). Increasing standards of living and economic growth are often based on excessive exploitation of natural resources, resulting in a conflicting view and understanding of natural resources within the U.S. If our urban ecosystems are to survive and thrive, we must change how we interact within this system.

Ecosystem management is a relatively new concept in the area of planning and natural resource management, especially when applied to urban systems. Past approaches have addressed natural resources separately from the human environment with a focus on “fixing” the problems created by people. At the same time, urban planning has emphasized the role of humans over the role of the environment. The underlying tenets of ecosystem management take a very humanistic view of resource management. This anthropocentric view takes into consideration the ecological, social, multiple uses, and sustainability factors associated with the human use of resources (Stanley, 1995). This represents a blending of the needs of people and environmental values.

The need for an ecosystem approach in urban environments is especially critical in the area of water resources. Small headwater streams make up approximately 80 percent of the nation’s stream network, of which 75 percent of these are first and second order streams (Leopold, 1964).

Small streams offer the greatest opportunity for exchange between water and the terrestrial environment referred to as a riparian zone. A key service streams and riparian areas provide is the filtering and processing of materials such as nutrients and pollutants. Headwater streams are probably the most varied of all water habitats, offering an array of habitats for plants, animals, and microbial life. The goal of protecting water quality, wildlife habitats, and other downstream resources is not achievable without careful protection of headwater stream systems.

The ability of freshwater systems to efficiently recycle and remain healthy determines the usefulness of water to human social systems (Naiman, 1995). Yet, the ever growing human population and its increasing demand for water compromises this capacity for renewal. Long-term societal stability is critically dependent upon gaining a better understanding of the ability of freshwater ecosystems to respond and adapt to the challenges of human generated pressures. Sound decision-making can be facilitated by incorporating information into resource planning that is gained through an understanding of the diverse ways in which people value riparian areas (Wagner 2008).

Scientific research on riparian processes and buffer effectiveness has been the basis for recommendations about buffer width and other aspects of design and maintenance. The science behind these recommendations includes the effectiveness of buffers in controlling sediment and erosion; protection of water quality through filtration of nitrogen, phosphorous, and other chemical and biological pollutants; and the ability of different types of vegetation (grasses, trees, and shrubs) to provide these services. Water quality is the standard used to measure the physical, chemical, and biological characteristics of water. The U.S. Environmental Protection Agency (EPA) is the regulatory authority responsible for enforcing the Clean Water Act and setting standards for drinking water, human contact, and healthy ecosystems. Most people relate to water quality in terms of safe drinking water and "fishable and swimmable" streams and lakes.

While there are no legal requirements for communities to support their ordinances with specific research into stream condition, stream order, water quality, or vegetative condition, many communities are looking for scientific research to provide a foundation for the decisions they are making related to natural resource protection. Local stream and natural resource assessments provide some of the scientific information leaders and citizens deem necessary to support and publicly justify a community-wide ordinance or even a regional conservation plan. An informed and responsive citizenry is more likely to support land use controls that protect water quality and other natural resources.

Local ordinance protection for streams and waterways generally includes riparian buffers and setback ordinances to establish soil condition and vegetation, slow runoff, and protect streams and other water resources. The multifaceted roles of riparian areas are dependent upon their position within a watershed. As such it may be necessary to manage these areas differently in relation to their stream order rather than applying a simple minimum buffer width to all situations. Substantial scientific research is available that provides guidance on buffer widths to protect water quality and create or maintain viable wildlife habitats. However, references on model ordinances like the one developed by the EPA (1995) states that buffer widths selected by the community will ultimately be determined by what the community is politically willing to support rather than the biological or scientific validation for such widths.

Meanwhile, communities see the continuing growth of federal regulations that protect natural resources, specifically water resources, as a growing burden especially given that these mandates are generally unfunded. Thus, there is a need for a new way of thinking that involves a more integrative approach to urban planning and policy making. One way that communities are able to take a more integrated approach is through watershed planning. This type of planning utilizes an ecosystem management approach at the scale of watersheds as a means of applying the principles of natural and social sciences to accomplish system-wide sustainability.

Purpose

The purpose of this study is to provide community planners and decision-makers with another model to assist in making resource-based planning decisions and policies. Given that most ordinances and other regulatory policies are based upon what the community is willing to support politically, it is critical to provide them with the tools to build this support. This study looks at how the City of Kansas City, Missouri (KCMO) has approached the problem of resource protection in a manner that integrated scientific knowledge and public involvement to achieve economic, social, and environmental goals in the short- and long-term. This may seem like a small issue in a region where land is perceived to be in abundance. However, it is a huge issue if communities throughout the Midwest and elsewhere in the nation are to keep from repeating mistakes made in the past.

My approach to this project stems from an interest in both ecology and planning. I began my career in urban ecology with the Missouri Department of Conservation, as the Urban Wildlife Biologist for the Kansas City, Missouri region. After six years of working with communities and citizens trying to balance natural resource protection with development, I decided it was time to pursue an advanced degree in planning. I wanted to know what policies and guidelines communities use to guide development and what the development process means to developers. I wanted more knowledge and tools at my disposal to better promote natural resource conservation in a manner that was acceptable to communities and developers. Shortly after starting my master's program, I switched employment from the public sector to the private sector, moving to a consulting firm that offers environmental planning and design, and landscape architecture services. As I learned about planning theory and methods I was able to put it to use in my new position as a Conservation Ecologist. I began working with the Community Planning and Development Department in 2002, assessing streams within the city limits to determine relative stability and quality. Subsequently, the City began a citywide streams assessment and development of the City's Stream Setback Ordinance.

Hypothesis

This thesis is a case study to evaluate the suitability of the Kansas City Stream Setback Ordinance as a model ordinance. The study will illustrate that it is a good ordinance that provides a clear example of the successful integration of competing goals and the public process and that such an ordinance can meet multiple objectives of the community from stormwater management to providing wildlife habitat and recreational amenities. Lastly, the study will evaluate the impact of this ordinance on the supply of developable land.

Model ordinances for stream buffers have been developed by the EPA (1995), Wenger and Fowler (2000), and most recently by the Chagrin River Watershed Partnership (CRWP, 2006). Each model is built upon the progression of scientific literature related to riparian processes and buffer functions. While the model ordinances integrate scientific knowledge to provide validation for their recommendations, they do not appear to integrate the critical component of public involvement into the ordinance adoption process. The KCMO ordinance integrated science and public involvement in an effort to achieve short- and long-term ecological, social, and economic benefits.

Study Opportunities and Constraints

This case study evolved over a number of years during the ordinance development and adoption process. Being a participant and observer throughout this whole process presented certain opportunities and constraints. The opportunities included: leading and participating in the stream and natural resource assessment studies; assisting with development of the ecologically based buffer guidelines; and participating in and observing the public involvement process with the Wet Weather Community Panel and public hearings. The constraints related largely to the overall politics of the adoption process. In an effort to minimize the influence of such politics on this study, information gathered was limited to documentation from public meetings and media, archival records, and direct observation of public meetings.

Summary of Findings

KCMO set out to develop and adopt a stream setback ordinance in an effort to protect water quality, control flooding, reduce erosion and sedimentation, and provide wildlife habitat, while preventing future infrastructure problems due to encroaching developments placed near valuable water resources. During the ordinance development process it became apparent that the stream setback ordinance would provide benefits to KCMO's Wet Weather Program. KCMO was faced with substantial and costly stormwater and combined sewer overflow issues. Protection of stream corridors throughout KCMO would also provide wildlife habitat, recreational corridors, and improve the quality of life for KCMO's residents.

By integrating natural resource preservation into the ordinance, KCMO has taken an approach to development that makes environmental, economic, and social sense. Development and adoption of the ordinance illustrates the challenge of understanding, protecting, and incorporating natural resources into development and stormwater management practices.

The Kansas City region appears to have taken a more integrated approach than most communities to development and adoption of their stream setback ordinance. In reviewing ordinances throughout the U.S., most communities do not appear to have relied upon scientific research, or natural resource or stream inventories to provide guidance in developing the regulations within the setback, floodplain, or sediment and erosion control ordinances they are using to protect streams within their communities. Nor do they appear to incorporate public involvement as a means of gaining support for such ordinances. Perhaps the political atmosphere did not permit the time necessary to integrate such a process or the community did not deem it critical to the implementation of an effective buffer ordinance. Regardless, KCMO decided to take this integrative approach.

Thesis Chapters

Adoption of natural resource based ordinances by local governments is generally a complex process involving scientific information, policy guidance, and public involvement. The stream setback ordinance adoption process used by KCMO integrated all of these factors. Therefore, urban ecosystems, riparian buffers and ordinances, and the role of science and public involvement in the decision-making process were the focus of the literature review in Chapter 2.

Chapter 3 describes the case study methodology, explaining what was done to gather essential information, identifying and describing the study variables, specifying the study setting, and providing a review of model ordinances for riparian setbacks applicable to this study.

Chapter 4 presents the KCMO Stream Setback Ordinance case focusing on the ordinance development and adoption process. Over the last few years, the proposed ordinance for KCMO went through several revisions to arrive at its current language. Through the integration of science and public involvement, the adopted ordinance provides greater ease of understanding and enforcement, development provisions and incentives, and natural resource protection.

Chapter 5 presents the discussion and conclusions drawn from the Kansas City case, providing descriptions and evaluations of successful measures used in the ordinance development process. This chapter evaluates the Kansas City case as it relates to other model ordinances, the high value placed on water quality, wildlife habitat protection, public involvement, and to the impacts on the supply of developable land.

Chapter 2 Literature Review

> *"Ecosystem management integrates scientific knowledge of ecological relationships within a complex sociopolitical and value framework toward the general goal of protecting native ecosystem integrity over the long term."* (Grumbine, 1994)

Water is likely the most regulated natural resource. Local regulation of water is still evolving as communities look for ways to protect water quality, minimize flood hazards, and manage stormwater. Urban growth requires water. Water quantity and quality issues are increasing with the increasing demands being placed on this valuable resource. Many communities are recognizing the economic value of protecting water resources for the benefit of public infrastructure, health, and community quality of life.

For the purposes of this case study, the literature review will define and discuss: urban ecosystems; riparian buffers; riparian ordinances; and the role of public involvement and science in public policy making as it relates to natural resource protection and urban development. Each section will then relate the review to the KCMO ordinance.

Urban Ecosystems

Cities are ecosystems with complex functions and processes that are controlled by climate, hydrology, soils, vegetation, and human interactions. Humans are part of ecosystems as they impact the environment and are in turn impacted by the environment surrounding them. Urban ecosystem functions are simultaneously affected and maintained by human and ecological processes. Planners must consider all of these factors if cities are to be ecologically resilient.

Studies of cities as ecosystems (urban ecology) seem to rest in two camps: natural and social sciences. In the natural sciences, urban systems have been studied from the perspective of determining human impacts on the environment and ecological systems. In the social sciences, urban systems have been studied from the perspective of human responses to changes in the environment. Today, both natural and social sciences are taking a different approach realizing that humans and ecosystems are very much integrated with each affecting and being affected by the other. There is an explicit need for integration of the concepts and methodologies of both natural and social sciences as ecology alone cannot provide the complex information needed by planners and managers (Niemela, 1999). Boyden (1993) stresses the need for this new approach to recognize the significance of the constant interplay between social, cultural, biological, and physical variables.

In trying to achieve a better understanding of relationships between cities and the natural environment, Alberti (2008) proposes a new approach that is a hybrid between urban and ecological theory. This coupled human-ecological systems approach focuses on the interaction between humans and ecological systems rather than studying their component parts separately. Alberti (2008) also proposes a hybrid model that is regulated by potential for change, degree of connectedness, and system resilience. By using such a model it may be possible to determine at what scale the spatial structure of ecological, physical and socioeconomic factors influence ecosystem function and how complex interactions between humans and ecosystem functions over multiple scales affect resilience. The “Wet Growth Idea” (Arnold, 2005) promotes a similar concept where growth and land use are sustainable with respect to water resources and aquatic ecosystems.

For urban watersheds to be resilient, hydrological processes must support human and ecological patterns. There is a significant statistical relationship between ecological conditions in streams and landscape patterns in cities (Alberti, 2008), creating a need for more research to explore the mechanisms by which urban development patterns affect the ecological conditions of streams. Linking Alberti's hybrid model to scenarios may be one way to develop a basis for understanding the processes and mechanisms that govern urban ecosystems.

KCMO is a diverse mix of human and natural ecosystems. KCMO began looking at policy development from an ecological perspective when it initiated stream assessments within municipal watersheds. KCMO has been taking a system-wide approach to stormwater management with the understanding that human and ecological systems are both integral components necessary to achieve a sustainable city. Niemela (1999) is correct in her statement that the study of ecology alone cannot provide the information needed. The answers to Kansas City's growing stormwater issues lie in a blending of natural and social science concepts, planning, and politics.

Riparian Buffers

There is a growing quantity of literature on riparian buffers that includes functions, appropriate widths, vegetation, management, and maintenance. Buffers should be placed on all streams regardless of size as overall effectiveness is a function of how many stream miles are protected. Small/headwater streams (1st and 2nd order) make up at least 80 percent of the nation's stream network (Meyers et al, 2003). Headwater streams provide important ecological services offering important linkages between land and water and the opportunity for exchange of nutrients, sediment and water. Impacts to headwater streams will affect downstream systems. Thus, maintaining healthy headwater streams and adjoining riparian systems is critical to the healthy function of downstream systems.

Riparian buffers perform a variety of valuable environmental, economic, and social functions. Programs that promote the multiple benefits of buffers including water quality and aquatic habitat functions are usually given higher priorities by local governments and have greater public support (CRWP 2006). The choice of buffer width by communities appears to be related to margin of safety or conversely acceptable risk. Wenger's (1999) guidance provides that buffer widths should be a minimum of 50 to 100 feet of native forest vegetation. Reducing impervious surfaces, managing pollutants on site and minimizing gaps in buffers must also be addressed in order to maximize buffer efficacy.

State and federal agencies view riparian buffers as effective best management practices (BMPs) for buffering aquatic ecosystems against nutrient stressors like nitrogen and phosphorous. While buffer width is a factor, other factors like soil type, watershed hydrology, and subsurface biogeochemistry play key roles in removing nitrogen. Despite significant research effort, there remains no consensus for what constitutes the optimum riparian buffer width to achieve maximum nitrogen removal (Mayer, 2006). Using buffers to achieve multiple goals generally results in wider buffers which may in turn result in greater removal of nitrogen from aquatic systems.

The implementation of federally mandated programs to protect water quality (National Pollutant Discharge Elimination System (NPDES) Phase II) is requiring action by local governments to implement stormwater BMPs with guidance and regulations and generally no funding (White and Boswell, 2006). In their study of Phase II implementation in California and Kansas, White and Boswell (2006) found that local governments in both states tended to respond to the mandate in similar ways. Performance did vary with local conditions, perceptions of the program, and characteristics of the implementers. Riparian buffers are considered acceptable BMPs for stormwater management in the NPDES Phase II Program. Implementation of a stream buffer program can provide communities with a low cost and minimal staffing option that meets the requirements for this unfunded, mandatory program.

KCMO has been investigating the use of riparian buffers as a primary tool within its KC-One Stormwater Master Plan. Buffers are relatively easy to implement with little to no implementation cost to KCMO while conversely providing multiple benefits including improved water quality, stormwater management, aquatic and terrestrial habitat protection, and recreational opportunities. Through the science of stream assessments and natural resource inventories, KCMO has been able to create maps highlighting priority areas, especially stream corridors for resource protection and to create habitat and recreational linkages. KCMO also utilized scientific research and literature reviews on stream buffers (Heraty, 1993; Wenger, 1999; Ilhart, Verry, and Palik, 2000; Mayer et al, 2006; CRWP, 2006) as a foundation for developing its own ordinance guidelines.

Riparian Ordinances

Local governmental powers are explicitly provided by the laws of most states, to conserve open space and natural resources, and to protect water quality. States and communities across the nation have been slowly implementing riparian buffer or stream setback ordinances to protect water quality and, more recently, to manage stormwater. There is increasing interest by local governments in economic development combined with a concern for healthy social and ecological communities. Riparian buffers are not only essential tools for environmental protection; they are also important factors in the long-term economic health of a community (Wenger and Fowler, 2000).

Establishing a legally defensible basis for determining riparian buffer widths can be accomplished through the use of scientific research (Wenger, 1999, and CRWP, 2006). Ecological science has provided research information and Geographic Information System (GIS) tools for planners to approach land use regulations with greater sophistication and precision. However, planners and decision-makers must have access to scientific information in a format they can use if they are to make science based decisions. To be most effective land use plans and ordinances should articulate clear standards, reflect public commitment, and have good political leadership (McElfish, 2004). Planners should examine the impacts of local decisions in a regional context (ecological vs. political boundaries) and over time, plan for long-term change in the landscape and the cumulative impacts of adjacent land use.

Regulations applied to streamside management zones on state and private forest lands were enacted as early as 1970 (US Forest Service, 1978). However, none of these early streamside regulations dealt with water quality. Apparently, the politically astute thing to do with water quality issues during the 70's was to tack them onto other legislation. Along with the lack of resource specific legislation, the general public had not been made aware of the social, environmental, and economic consequences of water quality problems. Times have changed and this is no longer the case regarding legislation or public awareness.

Buffer programs implemented at the state level often do not provide a uniform and effective system of protection. State buffer requirements in Georgia were found to create a patchwork of buffers of varying widths and extent. Wenger (1999) and Wenger and Fowler (2000), found that a lack of scientific foundation for these buffer requirements has afforded little protection for aquatic resources. Scientifically based guidelines for buffer widths, extent, and vegetation have been developed from an analysis of scientific literature. These guidelines can provide local governments an effective, legally and politically defensible riparian buffer protection program.

Local governments are taking a multifunctional interest in riparian buffers to address concerns for stormwater management; flood hazards; protection of water supplies; property and habitat; and community quality of life. Local governments are better situated to control activities on lands adjacent to wetlands and have an interest in ensuring compatible land use in order to maintain control of patterns of development, community character, tax base, demand for services, and response to hazards (McElfish, 2008). For communities to achieve effective results with buffer ordinances and meet any legal challenges, they must rely on good science. Multifunctional buffers should be sized to meet all of the functions identified as being locally important.

In a literature review of state and local urban riparian buffer programs nationwide, Heraty (1993) noted that riparian buffers ranged in width from 20 to 200 feet with an average of 92 feet. A majority of the programs had variable width buffers, required the presence of vegetation, and limited disturbances. Greater than 80% of the programs believed they had strong community support and that the buffers had a neutral or positive effect on adjacent land value. The EPA (1995) used Heraty's literature review as a foundation for establishing a model stream buffer ordinance to assist local governments in developing riparian protection programs. The extent to which the model ordinance is used to develop buffer widths is dependent upon the characteristics and sensitivity of the resource being protected and the political realities of the community (Heraty, 1993).

Through additional stream buffer research, McElfish (2004) noted that buffer ordinances across the nation prescribe a variety of widths and functions with 15 feet for the smallest and 350 feet per side for the largest buffer. Some ordinances set a distance of 500 feet for additional regulatory review. Most ordinances call for no or minimal disturbance of 50 to 100 feet on each side, likely based on Wenger's review of scientific literature (Wenger, 1999). Local governments use approaches ranging from fixed non-disturbance buffers, to matrix-based, to case-by-case. The range of practices for local governments to use in protecting riparian buffers is increasing due in large part to the wealth of scientific literature presently available. Lee et al (2004) compared national and regional differences in buffer guidelines throughout the U.S. and Canada in order to evaluate underlying riparian values embodied in forest management. The results of their study revealed that varying buffer widths reflected differences in the integration of ecologic, social, and economic factors. Management implications noted by Lee et al (2004) included a shift away from one size fits all buffers; improvements in BMPs for timber harvest near streams; an increase in knowledge base and public scrutiny; and a desire to protect the unique ecology of riparian systems. These implications will likely lead to a shift toward more complex guidelines and an expansion to larger watershed scale planning of riparian areas.

The Chagrin River Watershed Partners, Inc. (CRWP) provided an up-to-date review of scientific literature and technical information for decision-makers on developing and implementing riparian setbacks (CRWP, 2006). They reviewed recent literature with a broader scope in an effort to include significant contributions regarding scientific basis and new advances in understanding in recommendations. This continually improving knowledge base includes advances in understanding of riparian processes, and the value and importance of headwater streams on watershed hydrology and water quality. The CRWP's primary goal with this informative report was to provide partner members in northeastern Ohio with the best available science to support riparian setback regulations. By providing this base of knowledge, communities will be better able to validate the use of scientific literature and recommendations that balance riparian services with the beneficial uses of private property. The 2006 CRWP report also reflects the synthesis of interdisciplinary research now prevalent within the scientific literature. Several factors should be considered in implementation so that the setback is consistent with information provided by natural resource professionals, and represents a balance between maximizing riparian services while minimizing restrictions on beneficial land use by private property owners. These factors include: minimum width; expansion of width for floodplain, wetlands, and steep slopes; riparian area contiguity; types of vegetation; permitted and prohibited activities; and long-term management.

The model ordinance developed by the CRWP (2006) recommends widths ranging from 25 to 300 feet on each side of the stream channel dependent upon the size of the watershed and the wetland category/class. Wetland categories are characterized by CRWP ranging from low quality to high quality, dependent in part, upon their ability to support wildlife habitat, and hydrologic and recreational functions. Minimum setbacks are to be taken to the full extent of the 100-year floodplain and encompass riparian wetlands. The model ordinance also suggests permitted and prohibited structures and uses. A key feature of the ordinance is the emphasis on providing flexibility in other requirements such as side, rear, and front yard setbacks.

The implications of the CRWP guidelines (2006) and model ordinance are that stream and forest buffers and stream setbacks provide both site specific BMPs and a watershed scale management system. Stream setback regulations are only one part of the watershed approach to natural resource management and will not eliminate the need for engineered solutions where development has severely encroached upon riparian systems.

Implementation of this type of regulation will require a commitment of community resources. Therefore, communities should consider their level of technical and administrative resources available, community priorities for resource protection, current development levels, and specific characteristics of properties affected by the regulation. An effective regulation can result in a balance between riparian services maintenance and development patterns within the watershed.

Effective management of riparian systems is challenged by political boundaries and private property rights. Riparian setbacks are an attempt to implement a simple and cost-effective zoning tool that institutionalizes joint coordinated management of riparian resources. As communities grow and develop, this zoning tool can be used to maintain riparian functions and minimize encroachment on stream channels. This tool can also assist in providing a cost-effective alternative to engineered solutions and minimize the need for stormwater infrastructure. Overall, the setback ordinance must be justifiable in terms of protecting public health and safety; designed with impacts to private property in mind; and implemented with public understanding and support.

Preparations of the guidelines for the stream setback ordinance for KCMO included reviews of ordinances implemented by other communities (EPA 1995; Wenger and Fowler, 2000; Lee, Smyth, and Boutin, 2003; and CRWP 2006) to assist in determining what has been developed and implemented at the state and local level.

Role of Public Involvement and Science in Policy Making

Public involvement is a critical component of the public policy process. However, it has not always been a component of the process for political and other reasons. The presence of public involvement has been shown to have a long-term positive effect on the decision-making process even given its potential for extreme complexity.

In the public policy realm, the traditional role of the two-step scientific process where science finds the facts and policy makers make decisions is a fallacy. The endpoint in the public policy process is usually open-ended, arbitrary and determined by non-scientific factors. Because decisions are ethical, political and not factual, science can only inform policy makers. In determining the role of science in public policy making, Haller and Gerrie (2007) point to the need for a process that doesn't assume scientific input is required to make good decisions, nor that any scientific group has control. They see scientists as playing a supporting role to the political and ethical decision-making process. By letting contending participants find and present relevant scientific claims, only claims that can be compellingly presented will succeed in a democratic decision-making process that is inherently efficient. This should result in a return to the public hearing process where scientists are welcomed as participants and leaders.

When science, defined here as past and present scientific research and natural resource management, is part of the public policy process, debates often center on whether or not the public accepts or rejects the scientific basis for policy making. The scientific research used to support public policy should reflect public values. This has created a need for development of a process that allows citizens to direct science used to make policy and to help interpret the science, and one that allows science to better understand the values and concerns of citizens (Douglas, 2005). Collaborative analysis appears to be a reasonable model to directly involve the public in the study of technical issues. The model allows citizens to inform the scope of the analysis and provide local knowledge to improve data quality. This ensures that important decisions are shaped by the appropriate citizen values.

Values shouldn't replace evidence but should help make decisions under conditions of uncertainty. An additional benefit to this approach is that citizens gain a greater appreciation for the intricacies of scientific study and analysis relevant to their community.

Modern science and technology, major drivers in today's industrial economy, are presenting new risks to the environment and the stability of social systems. Increasing concerns about technological hazards and their impact on the environment is creating a need to extend science into the political decision-making realm. Involving the public in decisions where science is involved can be quite difficult. In the past, industry, politics, and science have generally been opposed to including the public, seeing technology and science based discussions as being above the average citizen's ability to comprehend. Fischer (2003) describes the failed effort to use Risk Assessment to examine the institutional and social effects of technological risks. This method, which was the product of a bureaucratic system, had a major technical problem in that it required analysts to make uncertain assumptions. Overall, the method failed to reassure the public who perceived it as hiding important political and social issues. Fischer (2003) goes on to propose a more participatory approach to research, one that integrates social learning and goal oriented decision making; requires time, political commitment and interpersonal skills; and builds credibility and acceptance of research findings. Improved communication of scientific findings is no longer good enough. In order to gain greater public participation and build social discourse into the scientific research process, there will need to be institutional and political change.

State and federal resource agencies have been implementing a collaborative approach to resource management to successfully manage public natural resources and stay in touch with changing public values (Wondolleck and Yaffee, 2000). Collaborative management provides a decision-making framework that involves multi-disciplinary groups (state and federal agencies, scientists, elected officials, and citizens) in ways that build understanding, support, and capacity. A collaborative approach can help agencies and interested stakeholders understand each other, while providing a decision-making framework that involves groups in a way that builds support and ownership (Wondolleck and Yaffee, 2000). This type of approach recognizes the need for a good foundation of science which is just one of many important considerations when making wise public decisions. The collaborative approach is well suited to planning and management issues due to its emphasis on achieving consensus through public involvement. While collaboration does achieve successful planning efforts, there is concern about taking it from the planning stage into implementation. Margerum's research (1999) of U.S. and Australian case studies showed that most cases could not get beyond shared capital to successful implementation nor could the groups involved cite examples of influencing policy or decision-makers or of resource allocation. Based on these case studies, it would appear that state and federal agencies may be more successful at applying collaboration from planning to implementation than local governments using this approach.

Public interest and involvement in riparian areas is increasing as most people have contact with riparian areas on a daily basis through work, recreation, or where they live. People are connected with the physical and biological dimensions of ecosystems. In their research on the cultural impacts of urbanization, McDaniel and Alley (2005) found no significant relationship between environmental knowledge and gender, education or income. However, local environmental knowledge is directly tied to experience with the land and the local environment, creating a greater relationship between knowledge and contact with nature.

Relationships between people and riparian areas change with changes in population and its distribution over the landscape. As urbanization increases, local environmental knowledge tends to decline. Therefore, it becomes critical for communities to reconnect people to nature; this can readily be done through implementation of riparian buffer programs. As people interact with riparian areas, it becomes more important to understand their needs and desires and to integrate human dimensions into the management of riparian systems (Dwyer, 2000). Nassauer (2001) introduced the idea of cultural sustainability, which refers to ecologically beneficial practices that elicit sustained human attention over time. People are more likely to accept and protect what they know and value. Therefore, if they value a riparian landscape that is ecologically beneficial, they are more likely to accept and protect it. Nassauer (2001) also makes the interesting note that public landscapes are those owned in some way by all who "see" them. Emphasis should be placed on creating innovative designs that achieve ecological goals while being sufficiently familiar in appearance to reflect public and private values (Nassauer, 2001).

Wagner's (2008) study on urban riparian buffers and stormwater BMPs concluded that people have a broader, more complex valuation structure regarding streams and riparian areas. Of particular note is that riparian landowners identified a combination of environmental, social, and economic values associated with these areas. Regardless of whether participants lived and/or worked near streams, respondents demonstrated an understanding of the multifunctional importance of riparian areas within the landscape which is in contrast to previous research that emphasized aesthetics (Nassauer, 2001). People are able to describe riparian buffers using attributes that are visually recognizable and, thus, do not require scientific delineation of riparian areas (Wagner, 2008). In an earlier study Wagner and Gobster (2006) found the interface between landscape change and its social context to be spirited and complex. They noted that participants in their stream assessment related to changes in stream flow and water quality rather than the more technical aspects of stream science. Therefore, data should be within the realm of public experience or be capable of being translated in ways that have meaning and relevance to people (Wagner and Gobster, 2006).

Given the complexity of riparian systems, managers and planners will seldom if ever, have complete information upon which to make decisions. However, they can reduce the amount of uncertainty within their decision-making process by gathering information from multiple sources and maintaining meaningful and relevant communication with the public. Taking a participatory or collaborative approach to planning requires a commitment on the part of the decision-makers and the community involved.

Kansas Citians were publicly involved in KCMO's Wet Weather Community Panel, part of KCMO's Overflow Control Program for combined sewer overflows, for over five years. KCMO was faced with a multi-billion dollar problem related to stormwater and combined sewers which would require increased rates for services. Thus, citizen involvement played an instrumental role in encouraging KCMO to follow through with adoption of the stream setback ordinance in support of the goals and objectives of both the KC-One Stormwater Master Plan and the Overflow Control Program. Additionally, citizen surveys conducted by the region's Mid-America Regional Council (MARC) and KCMO showed overwhelming support for water quality and aquatic habitat protection.

Summary

Cities are an integration of human and ecological processes. The natural and social sciences appear to be in consensus that if we are to truly understand urban systems then future study should include both human and natural systems. The hybrid model proposed by Alberti (2008) may indeed prove to be the best method for studying urban ecosystems.

Nationally, there is a vast knowledge base on appropriate riparian buffer widths that can provide the scientific foundation many communities are looking for to legally and politically defend a riparian buffer program. While the CRWP (2006) claims that there is now a sufficient scientific knowledge base to support buffer regulations, Haller and Gerrie (2007) counter that communities should not place too much emphasis on scientific research to justify their open-ended, somewhat arbitrary political processes.

The integration of biophysical and social science has a clear role in the development of local policy making (Wagner, 2008). Communities and resource managers are finding that resource management plans, including riparian protection programs, have greater support by the public when they involve the public in the planning process. People are generally no longer willing to accept being told that the scientists and decision-makers know best. They are demanding to be informed and included in the decisions impacting their communities. While the public involvement process may seem cumbersome, many researchers, planners, and decision-makers have had to bear the outcomes and the costs of not involving the public. By putting the ecological benefits of riparian systems in terms people can relate to (Wagner 2008) such as water quality and wildlife habitat, support can be garnered for implementation of measures such as ordinances to protect riparian buffers and their functions.

Currently, the CRWP technical guidance and stream setback model is the most comprehensive model available to provide an ecosystem approach for communities seeking to implement such an ordinance. However, like past models (EPA, 1995; and Wenger and Fowler, 2000), the CRWP model does not attempt to integrate public involvement, nor do any of these provide case studies of the successful implementation of such an ordinance to further assist communities in what can be a cumbersome development and implementation process. Along with scientific knowledge, communities often look to other communities for examples or case studies of successful processes.

The ordinance developed by KCMO took advantage of the vast scientific research base on stream buffers as well as local data to provide an ecosystem approach to creating a functional buffer system for KCMO's valuable water resources. The ordinance process also utilized public involvement and the need to meet federal water quality regulations to gain stakeholder buy-in necessary for political support of the ordinance. This ordinance is illustrative of a successfully integrative process that other communities can use to implement similar ordinances.

Chapter 3 Methodology

> *"The United States has developed the most extensive scientific and technical capacity of any country to support environmental policy-making."* (Andrews, 1999)

The KCMO stream setback ordinance appears to be an example of ecosystem planning in an urban context, and to offer a model to other jurisdictions. This model illustrates the integration of science and public involvement in an effort to achieve water quality protection. The ordinance appears to meet multiple community objectives from stormwater management to recreation and wildlife habitat.

Case study methodology was used to define, gather and analyze data, and present the findings for this research. A case study is an empirical inquiry that investigates contemporary phenomenon within a real life context, especially when boundaries between phenomenon and context are not clearly evident (Yin, 2003). Case studies often cope with technically distinctive situations in which there are many more variables of interest than data points. Generally, a case study attempts to illustrate why a decision is made, how it is implemented, and what the results are. Case study methodology is most suited to this study due to the how and why type of questions being posed; the lack of control by the investigator over the actual behavioral events; and the contemporary focus of the research. My role in this case study was both as a participant and observer which provided unique opportunities and constraints.

Opportunities and Constraints

This study focused on questions related to the ordinance development approach taken by the City of Kansas City and how the City achieved integration of scientific information and public involvement during the adoption process. The contemporary focus of the study is directly related to the necessity of KCMO to take action to protect human health and safety, infrastructure, and natural resources as illustrated by a long history of issues related to the impacts of developments located adjacent to valuable water resources.

As a participant/observer in the citywide stream assessments and development of the ordinance language and adoption, I had the unique opportunity to participate in and evaluate the ordinance process from early development through adoption. In an effort to remain neutral in presenting this case study, I have limited my questions to the integration of science and public involvement. The adoption of the ordinance did entail various levels of politics of which I chose to focus on public involvement as this presented a uniquely dynamic and critical component to the whole study. Future study could explore the additional political dynamics of the planning process as these generally do play a major role in the final outcome of ordinance adoption.

Data Collection

Case study evidence included documentation, archival records, direct observations, and participant observation. Evidence in the form of documentation was acquired through meeting agendas and minutes from the City Plan Commission and Wet Weather Community Panel; media and newsletter articles; local policy guidelines and resolutions; and an extensive review of scientific literature (presented in Chapter 2). Archival records included the 2005 ETC Citizen Survey for the Wet Weather Program, stream buffer maps, and a green solutions position paper. Direct observations were made by the investigator during Wet Weather Community Panel meetings and public meetings held to discuss new development codes including the stream setback and open space and conservation development ordinances.

Participant observation involved participation in the Wet Weather Community Panel work sessions and preparation of the scientific information used to develop the guidance for the buffer widths.

Several municipalities in the Kansas City metropolitan region have implemented stream buffer or setback ordinances within the last few years. Many others have implemented the minimal standards provided by the Kansas City Metro Chapter of the American Public Works Association Section 5600 Stormwater Design Criteria (APWA, 2006). Others have taken a more comprehensive and scientifically based approach to developing and implementing their buffer ordinances.

The variables used within this study include the setback ordinance, scientific research (from literature reviews), and stakeholder involvement throughout the development and adoption process. Literature reviews of scientific research by Heraty (1993), Wenger (1999), Lee (2003), and the CRWP (2006) were utilized in an effort to limit the need for additional research on the function and value of riparian buffers. The setting for this study is the City of Kansas City, Missouri, with data collection beginning in 2001 and ending with ordinance adoption in August 2008.

Data Analysis

Several factors will be used to measure the success of the ordinance in integrating science and meeting standards established by previous model ordinances, balancing competing goals, and integrating public involvement.

Model ordinances have been developed for communities throughout the nation by the EPA (1995), for communities in Georgia by Wenger and Fowler (2000), and for northeastern Ohio communities by the CRWP (2006). All are iconic in that they utilize advances in scientific research to establish recommendations for minimum buffer widths and expansion factors. Each of these models provides recommendations for buffer widths, type of vegetation, permitted and prohibited activities, and administrative components. The models developed by EPA (1995) and the CRWP (2006) represent planning and policy development in the form of ordinances. The model proposed by Wenger and Fowler (2000) is a planning overlay zone. Along with the model, the CRWP (2006) provides valuable technical guidance including numerous factors for buffer expansion. A summary of the elements within three model ordinances is presented in Table 1 with a synopsis of the ordinances presented in the Appendix.

		EPA	Georgia	CRWP
Base Factors	Science Based	Yes	Yes	Yes
	Mapped Streams	USGS topo map	2nd Order and Higher	USGS topo map
	Buffer Zones	3	1	1
	Minimum Width (ft.)	100	100	25
Expansion Factors	100-yr Floodplain	X		X
	Wetlands	X (or Critical Areas)		X
	Steep Slopes	X		X
	Vegetation			X
	Other	Stream Order, Water pollution hazards	water supply watersheds	Riparian area contiguity

Table 1. Comparison of minimum buffers provided by three model ordinances.

A number of competing goals related to the setback ordinance will also be used to evaluate measures of success of the ordinance, including:

- Control flooding
- Protect infrastructure
- Improve water quality
- Conserve soil

- Manage stormwater
- Maintain riparian area contiguity and connectivity
- Protect terrestrial and aquatic habitat
- Create recreational amenities
- Retain developable land

While the success of some of these factors can be determined within this study, e.g., the amount of developable land retained and riparian area contiguity, others will need longer term study to determine the real measure of success through demonstrable improvements in water quality, flood damage costs, and wildlife habitat use. A final measure of the success of the ordinance within this study will be the integration of public involvement. This will be evaluated through documented involvement and the public survey results.

Summary

Each of the model ordinances illustrates the evolution of research and thinking in the scientific community regarding appropriate buffer widths. The extensive research utilized to develop these models demonstrates the necessity for decision-makers to determine the characteristics and sensitivity of the resources they desire to protect as well as the political realities of their community (EPA, 1995).

Chapter 4 will provide a detailed description of the KCMO ordinance process and the contributions these models made to the development of base widths and expansion factors incorporated into the stream buffer zones. The final KCMO setback ordinance will be evaluated against these ordinances to determine the success of the ordinance in integrating scientific research and meeting or exceeding minimum standards established by past research utilized within the model ordinances. The

KCMO case will also illustrate the necessity and value of balancing competing goals and incorporating public involvement to achieve resource and water quality protection at the watershed level.

Chapter 4 The Kansas City Case

> *"It's not just about water. It's about a stronger, more prosperous and sustainable community."* (Dr. Deborah O'Bannon P.E., Wet Weather Community Panel Member)

Development and adoption of ordinances aimed at protecting a community's natural resources is a lengthy process. With the more successful processes, communities take the time to assess existing resources, review local and national ordinances, and involve local stakeholders. In the case of KCMO, a number of projects, city departments, and the community at large had been pushing for the stream setback ordinance several years prior to actual ordinance adoption. It has been this continuous progression and intense involvement that led to the development and successful adoption of this unique ordinance.

Kansas City is located in the heart of the Midwest. It is within 250 miles of both the geographic and population centers of the United States. Kansas City is the largest city (by population and land area) in Missouri and the second largest metropolitan area within the state behind St. Louis. KCMO encompasses 318 square miles (203,520 acres) of land within Jackson, Platte, Clay, and Cass counties. Of this, 313.5 square miles (200,640 acres) is land and 4.5 square miles (2,880 acres) is water. There are 35 HUC-14 (hydrologic unit code) watersheds located within the municipal boundaries of KCMO. Kansas City represents a transition zone between the eastern hardwood forests and the western prairie grassland ecosystems. As such, it provides varied ecological conditions which support diverse plants and animals.

As of 2008, more than 50 percent of KCMO was developable land. Growth in housing units from 1990 to 2000 in Cass, Clay, and Platte counties was 30.2, 21.0, and 26.8 percent respectively. Given the amount of land available for development, the potential for impacting water and other natural resources within this large geographic area, and KCMO's past history of development issues related to stormwater, it was critical for KCMO to take major steps to implement an innovative stream protection ordinance to reduce flooding and protect water quality and city infrastructure.

Pre-Ordinance History

KCMO's Planning and Development Department (CPD) is the lead agency for physical and economic development within the city. It is responsible for long-range land use plans; urban design guidelines for special review districts; reviewing all development activity by KCMO Plan Commission, Board of Zoning Adjustment, and the Planning, Zoning, and Economic Development Committee (EDC) of the City Council; and for providing development information to property and business owners, developers, and design professionals (KCMO, 2010). The CPD began conducting watershed studies in 2001/2002. The intent of these studies was to provide City staff with the tools and knowledge to make informed land use decisions related to impacts by development on natural resources, specifically water resources.

This initial effort was followed by the implementation of a citywide stream assessment as part of the KC-One Stormwater Master Plan, led by KCMO Water Services Department (WSD). The assessment was conducted in the 35 watersheds located within KCMO's municipal boundaries. The purpose of the assessment was to determine the general condition and resources of streams within the city. Base knowledge gained from this inventory would be used to identify environmentally sound (green) stormwater management solutions; locations for high priority stormwater facilities; locations of high priority conservation and restoration sites; and to make ecologically sound land use decisions. Results of the inventory revealed the condition (stream type) for most (70 percent) of KCMO's streams to be in the mid-range or restorable condition.

KCMO established a Wet Weather Program to coordinate KC-One along with the Overflow Control and Waterways programs. The purpose of this umbrella program was to bring these separate programs together to consider the use of one solution to meet many objectives and be more cost effective. Addressing flooding, sewer overflows, and water quality were the primary goals of this program. The goals of the KC-One program were to bring KCMO's 35 watershed master plans together into one Comprehensive Stormwater Management Plan and to detail KCMO's strategy, policy, capital program, and administrative plans for the future of the stormwater management program.

Policy recommendations developed in the KC-One program included stream corridor protection and enhancement, in support of the effort to develop and implement an effective stream setback ordinance. Another major factor driving WSD's decision was the existence of 3,000 inhabited structures located within the 100-year floodplain. It was evident through efforts by the CPD and the KC-One program, that implementation of a citywide stream setback ordinance tailored to the needs of Kansas City, was a critical first step KCMO could take with little to no cost to the City.

The Mid-America Regional Council (MARC) is the metropolitan planning organization for the nine counties and 120 cities within the bi-state Kansas City region. MARC began a region-wide natural resource inventory (NRI) in 2003 to develop a comprehensive database and Geographic Information System (GIS) mapping depicting regional natural resource assets and ecological land features. Primary mapping layers depicted vegetative resources, natural resource features, and regional infrastructure. The results of the NRI showed that 22 percent of the metropolitan region retains areas of good to high quality vegetative communities and that these resources tend to be concentrated along the region's rivers and streams, near open water and on steep slopes. These resources play an important role in creating buffers to protect streams.

Projects like this have been completed in Chicago, IL; and Milwaukee, WI; with the goals of improving air and water quality, reducing flood damage, conserving ecosystems and biodiversity, and becoming models of sustainable urban development. This tool was the region's first step toward environmental planning at a local level that uses a systems based framework to implement watershed management, resource conservation and ecological restoration at a regional level. Implementation of stream buffers was one of several steps identified within the possible policy approaches resulting from this inventory. MARC has encouraged the use of this tool by municipalities, counties, and planners throughout the region to assist in developing new policies and infrastructure plans to meet the needs of existing and future development.

In an effort to promote implementation of BMPs in new development, KCMO adopted the Kansas City Metro Chapter of the American Public Works Association *Section 5600 Stormwater Design Criteria* in October 2006. These newly updated design criteria now include requirements for water quality protection. The guidelines encourage communities to preserve streams as systems by adopting comprehensive stream preservation and buffer zone requirements. Where such comprehensive strategies are not in place, the default Section 5600 Criteria apply for all proposed development and redevelopment adjacent to or ultimately discharging into an existing natural channel. Buffer widths from the ordinary high water mark outwards, measured separately in each direction are 40, 60, 100, or 120 feet, dependent upon the size of the contributing watershed. These buffers provide minimal protection for KCMO's streams and adjoining natural resources and do not prevent new homes and businesses from being built in flood prone areas. By developing and implementing a more comprehensive stream setback ordinance, KCMO realized it could avoid future liabilities through protection of new infrastructure and development from flood damage and protect the natural resources that provide multiple benefits to its communities.

Ordinance Development

In 2005, the CPD began work on a stream setback ordinance as part of its development code update. The initial setback ordinance was based on the proposed ordinance being developed in Johnson County, Kansas (one of nine counties in the metropolitan region); which was in turn modeled on the Lenexa, Kansas ordinance adopted in 2002. Buffer widths proposed in this ordinance (Table 1) were based on stream order, the location of the stream within the watershed, and stream quality resulting from a county-wide stream assessment.

Stream Size	Types 1 & 2 Streams (High Quality)	Type 3 Streams (Restorable)	Type 4 & 5 Streams (Low Quality)
Smallest To Largest	300 ft	250 ft	200 ft
	250 ft	200 ft	150 ft
	200 ft	150 ft	100 ft
	150 ft	100 ft	50 ft

Table 2. Stream buffer minimum widths based on stream size and type proposed for unincorporated Johnson County.

While this approach used local stream inventory research to inform decisions, it was decided that this information was too narrowly focused (one point in time) and too open to interpretation to be valuable over the long term. It was also determined it could not be easily and consistently administered due to its complexity. Case in point, the City of Lenexa used its stream and natural resource inventory to create buffers like those in Table 2. The greatest protection should be afforded to smaller headwater streams in order to have the most value for the whole watershed. However, it is counter intuitive to most people to put larger buffers on smaller order streams. The City of Lenexa was unable to convince its development community of the logic of this approach. Therefore, while still a comprehensive buffer ordinance, the buffer widths ended up reversed with the smallest buffers being applied to the smallest streams.

The development community initiated contact and became involved with the CPD in the development of the stream setback ordinance in the spring of 2007. WSD and CPD specifically met with a group of development attorneys and engineers several times over six months to gain their input on the ordinance language. Comments and suggested improvements are reflected in the details of the final ordinance. This development group requested certain criteria be addressed by the ordinance, including:

- Clearly defining regulated streams
- Being easy to understand and administer
- Applying uniformly and equally to all streams and projects, including all City projects
- Using common information
- Incorporating the latest scientific research and buffer recommendations

In an effort to provide greater consistency in interpretation and administration, as well as streamline the process for the development community, KCMO began to look at existing scientific information that could be used to justify appropriate buffer widths. Review of a wealth of scientific literature on appropriate buffer widths provided a range of recommended widths from 10 to 300 feet from stream centerline or top of bank, dependent upon the desired function of the buffer (EPA, 1995; Wenger, 1999; CRWP, 2006). Scientific literature provided buffer widths for protecting and enhancing water quality and providing habitat for a variety of plant and animal species. Overall, the literature concludes that the best approach is one that protects functional riparian systems (vegetative communities) adjacent to streams, especially woodland systems as these provide the greatest water quality protection (Wenger, 1999; Wenger and Fowler, 2000; CRWP, 2006). In addition to research on stream buffer widths, KCMO looked at research related to defining riparian corridors and model stream buffer and setback ordinances to better understand the factors included within the ordinance that would provide the greatest benefit to the resource and be acceptable to the community.

The next iteration of the draft setback ordinance removed consideration of the stream order and quality (stream typing based on the citywide stream asset inventory). The ordinance evolved into a three-tiered riparian buffer system (see Figure 1) with a streamside, middle, and outer zone. The proposed buffer zones consisted of a 25-foot streamside zone; a variable middle zone that included the Federal Emergency Management Agency (FEMA) mapped 100-year floodplain or the unmapped 100-year conveyance; and a 25-foot minimum outer zone that included any contiguous vegetation mapped by the MARC NRI or field determined, or contiguous slopes steeper than 15 percent. As ordinance development continued into the spring of 2007, it was decided that the ordinance would be applied to all streams regardless of whether or not they were mapped by the MARC NRI.

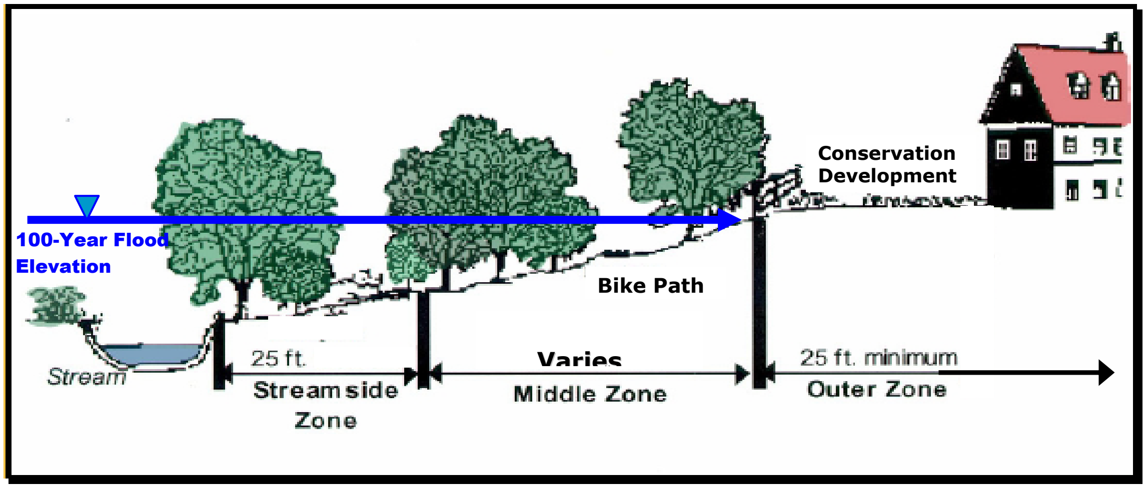

Figure 1. Three-tiered riparian buffer system.

Throughout the ordinance development process KCMO used GIS mapping of the potential buffers to determine the impacts the ordinance could have on developable land within the city. The mapping indicated that the ordinance would limit development of approximately 25 percent of the undeveloped land within city limits. Approximately 13 percent of this undeveloped land lies within the 100-year floodplain, which would be undevelopable. It is extremely important to note that all parties involved agreed from the start that development would not occur within the floodplain. In order to offset the potential loss of the remaining 12 percent of developable land, KCMO was willing to offer flexibility and incentives to encourage more sustainable development. These included density bonuses, smaller lot sizes, and more flexible site design standards. Developers would be allowed to clear and build on up to 40 percent of the outer zone area (or 50 percent with on-site mitigation) and would be encouraged to use conservation design standards for this area: residential developments would have a reduced minimum lot size and internal setbacks that would allow for a 20 percent increase in total lots, despite the reduced development area. Non-residential developments would be allowed a 20 percent increase in building heights and a 20 percent reduction in parking requirements.

By the summer of 2007, the stream buffer standards were to be applied to all stream corridors identified on the "Kansas City Natural Resource Map" (see Figure 2).

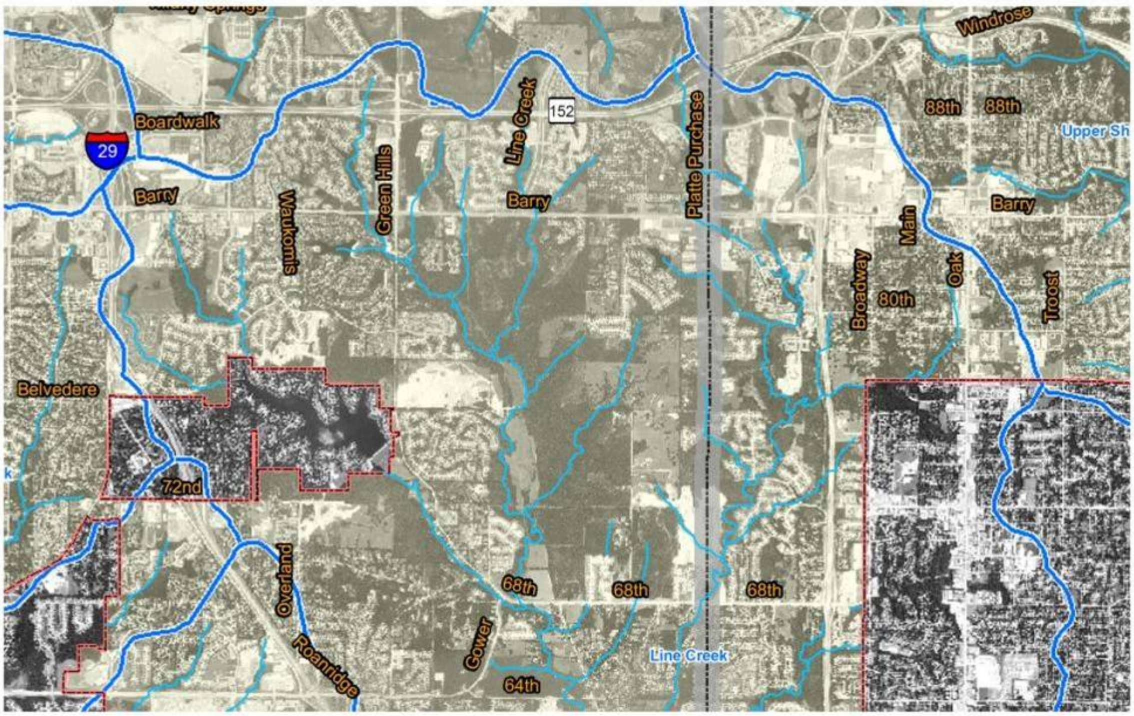

Figure 2. Kansas City Natural Resource Map indicating regulated streams in light blue, watershed boundaries in dark blue and municipal boundaries in red.

Buffer provisions would also apply to relocated streams and their mitigated natural resources. The standards did not apply to storm sewer systems, human made channels (except those designed to function as natural streams), or roadside ditches. The outer zone had been further refined to specify steep slopes in excess of 15 percent or "mature riparian vegetation" areas contiguous with the middle zone. Mature riparian vegetation was defined as tree species found adjacent to streams with a diameter breast height of 10 inches or greater and comprising 50 percent or more of the riparian tree species present. Forest vegetation was selected due to the evidence of water quality protection provided in the scientific literature, and to the need for adjacent homeowners or businesses to simply and effectively identify and manage vegetation within yards or other open space from that of the buffer zone. The outer zone did not have a numerically defined maximum limit.

The reason for avoiding an arbitrary maximum distance was to not diminish the benefits of the ordinance in areas with significant mature riparian vegetation. The ordinance would only affect properties with mature riparian vegetation or steep slopes, and developers would still be guaranteed the right to develop.

GIS mapping was used to assist developers in visualizing the approximate boundaries of the 100-year floodplain and 100-year conveyance as well as the mature riparian vegetation. As of 2007, over 50 percent of the land area within city limits was developable. Results of the GIS mapping showed that approximately 8 percent (9,100 acres) of the city would be in the middle zone, and a maximum of 17.9 percent (20,600 acres) could be covered in mature riparian vegetation. Of the vacant non-residential parcels within the city, only about 1,937 acres would be in the buffer, and 640 acres would be within the mature riparian vegetation.

Due to development community opposition over the potential for an unlimited outer buffer zone, KCMO chose to illustrate the ordinance intent by field surveying riparian buffer widths on City property adjacent to the Kansas City International Airport (KCI). KCMO has approximately 6,000 acres of vacant land surrounding KCI with numerous wooded stream corridors throughout that would provide sufficient area for testing the proposed ordinance. Field surveys were conducted throughout the property in the fall of 2007, and the results were used to compare the field survey to the original GIS mapping. In all locations field surveyed, results indicated that the limits of the outer zone would be less than the initial GIS mapping had indicated due to the absence of closed tree canopy or change in vegetation from mature riparian to upland species (necessary criteria for defining the Outer Zone). Using the field survey results, KCMO tried to illustrate that the outer zone would be limited by the extent of trees and steep slopes adjacent to the floodplain where mature riparian vegetation no longer dominates the vegetative community. The field survey showed that even in cases where the adjacent woodland appeared to be expansive (relatively few areas in the city), it very quickly changed from mature riparian species to upland species (see Figures 3-4 below).

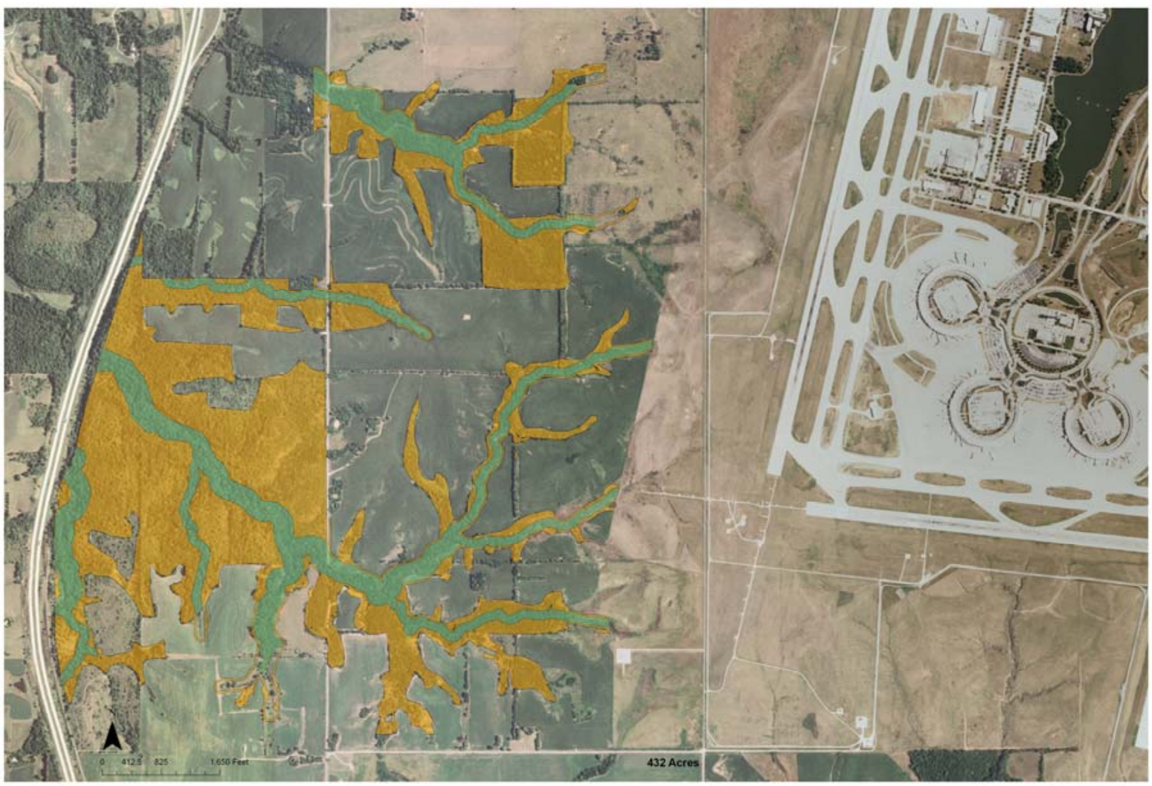

Figure 3. GIS mapping of approximated mature riparian vegetation area. Streamside and Middle Zones are in green, Outer Zone is in yellow.

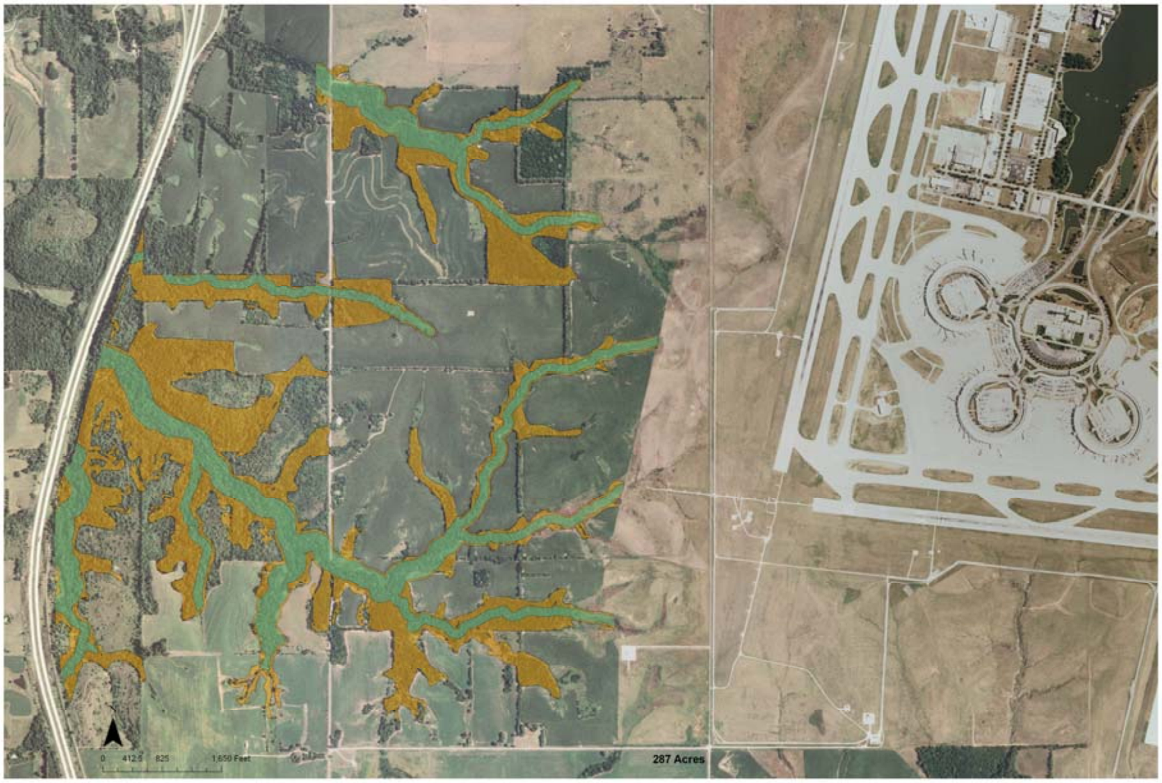

Figure 4. GIS mapping of field surveyed mature riparian vegetation. Streamside and Middle Zones are in green, Outer Zone is in yellow.

Of the approximately 600 acres of vacant non-residential parcels (0.5 percent of KCMO's developable land) potentially within the mature riparian vegetation of the outer zone, on average only one-third of the parcels are wooded or have steep slopes. After clearing 40 percent of the outer zone, 85 percent of the typical site could still be developed. Through GIS mapping, KCMO identified 160 acres of vacant parcels that could be 75 to 100 percent undevelopable with this ordinance. Of these, 130 acres were at least 75 percent within the 100-year floodplain and the remaining 30 acres were at least 50 percent within the 100-year floodplain. Despite the limited potential for regulatory takings, KCMO developed a variance process along with mitigation options for cases of extreme hardship.

The development community still balked at no maximum limit to the outer zone even after seeing the field survey illustration. They cited KCMO as being the only one in the country that was trying to adopt a setback ordinance with no maximum limit. So KCMO continued to work to reach a reasonable compromise on the width of the outer zone. In an effort to provide the development community with a more defined limit, KCMO and development community contemplated various widths for the outer zone including: 300-foot no build or 500-foot with up to 40 percent clearing and conservation development allowed.

By spring of 2008, KCMO and the development community had refined their discussions to the proper definition of the outer zone. The development community did not want the requirement to field verify the extent of the outer zone. They decided it would be more prudent to have a fixed distance determined with limited consideration of the site. After several months of back-and-forth discussions and proposals by KCMO and the development community, a compromise was reached. The final ordinance used criteria similar to those provided by other agencies like FEMA and the U.S. Army Corps of Engineers.

The final ordinance maintains a 25-foot streamside zone (see Figure 5). The middle zone incorporates the FEMA or city-designated 1 percent (100-year) floodplain or the limits of the 1 percent (100-year) conveyance determined by the project engineer, and jurisdictional wetlands. The outer zone extends 75 feet from the outer edge of the middle zone and includes slopes greater than 15 percent or mature riparian vegetation areas contiguous with the middle zone. If steep slopes or mature riparian vegetation are present, the outer zone is expanded to encompass these resources. The outer zone, which becomes permanent open space, is considered an area and not a set distance. A continuous zone of vegetation of at least 25 feet adjacent to the middle zone must be maintained to avoid fragmentation of the vegetated area. The maximum extent of the outer zone is established at the landowner's election, as follows:

1.) A total of 150 feet from the outer edge of the middle zone provided that 100% of the outer zone is set aside as permanent open space; or
2.) A total of 250 feet from the outer edge of the middle zone if a portion of the zone is to be developed pursuant to the Open Space and Conservation Development option in 80-209 Section 65-06(c)(2) through 65-06(c)(4) and 65-08(c)(1).

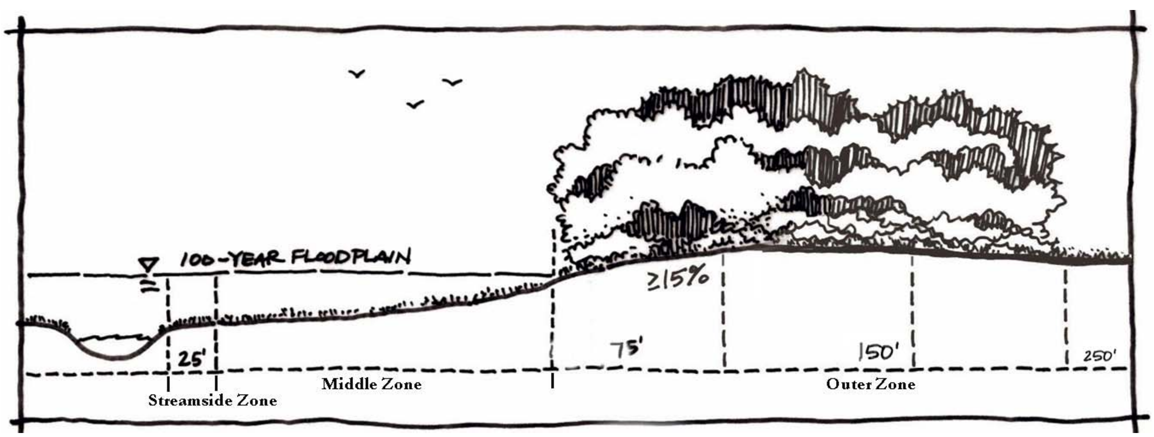

Figure 5. Three-tiered buffer zones as defined within the final setback ordinance.

The ordinance provides for allowable uses within the various zones with the type and number of uses increasing with distance from the stream as dictated by the buffer zones. The streamside zone is the most restrictive. Activities are limited to vegetation management; streambank stabilization; road, trail, and utility crossings; and properly designed stormwater outfalls. Middle zone activities include those within the streamside zone as well as underground utility corridors and paved and unpaved recreational trails with proper vegetative restoration. Activities allowed within the outer zone (permanent open space) include those within the streamside and middle zones, as well as stormwater BMPs. Permanent buildings are not allowed within any of the buffer zones. The ordinance specifies a number of additional uses that are allowed within the stream buffer zones, provided that the mature riparian vegetation is disturbed as little as possible. Some of the activities included are: existing and on-going agricultural activities (except in the streamside zone); control of noxious and/or invasive vegetation; maintenance and repair of public streets and rights-of-way; and open space uses that protect natural resources such as wildlife sanctuaries.

Additional standards within the ordinance apply to contiguous vegetation, stormwater discharge, mitigation, buffer plans, and boundary markers. Mitigation criteria are provided for landowners who elect to establish the maximum outer zone width and who exceed the 40 percent disturbance limit (up to 50 percent). The mitigation must be contiguous to the outer zone. Additional mitigation may be permitted with justification; requirements are determined by the location and amount of disturbance and the location of the mitigation. This is similar to how the U.S. Army Corps of Engineers determines mitigation ratios for impacts to wetlands.

Ownership and responsibility for the stream buffers established by the ordinance remain with the landowner. The buffers must be protected in perpetuity by drainage or conservation easements; restrictive covenant or dedication to KCMO with the City's acceptance.

GIS analysis was again used to illustrate the impact of implementation of the ordinance on developable land throughout Kansas City. The analysis showed that the ordinance would result in only 4 percent of the developable land and 8 percent of floodplain area being preserved in permanent open space, and that 96 percent of the land would continue to be open to development.

The final stream setback ordinance was adopted by City Council on August 20, 2008, and became effective February 14, 2009.

Public Involvement

KCMO city staff and consultants conducted 40 meetings over 18 months with the development community, City government, environmental groups, and the public. Participation by the development community was described in the process above. Community participation in the development process for the stream setback ordinance occurred in several ways: Development Code Steering Committee; Wet Weather Community Panel; public hearings; presentations to civic groups; and community surveys.

The Development Code Steering Committee was established to assist in the development and review of the revised development codes. Members of the committee were appointed by KCMO to serve throughout the code development process and to represent: the development community; Environmental Commission; design and planning; Plan Commissioners; Downtown interests; and consultants. The committee met every other month and was provided two presentations specific to the stream setback and open space and conservation development ordinances.

The ordinance was presented in 2007 to KCMO's Wet Weather Community Panel, a 50-member citizen panel established in 2003 with members representing a variety of groups including: residents, businesses, environmental groups, local technical specialists, MARC, and City Council District representatives. The Wet Weather Community Panel goals were to provide the community with opportunities for input and feedback; develop public awareness of social, economic, and environmental consequences; notify the public of meetings and other opportunities for input; and to enhance community understanding and acceptance of the Wet Weather Program. The Community Panel provided community support for the ordinance in the form of a resolution letter endorsing the adoption of the setback ordinance.

The Wet Weather Community Panel was also able to provide support for the ordinance as part of the Long-Term Control Plan (LTCP) for the combined sewer overflow program. In the spring of 2007, the EPA published a national policy memorandum that encourages the use of green infrastructure as a significant and valuable component of efforts by communities to meet regulatory requirements related to a broad range of water quality standards (EPA, 2007). KCMO was able to use the ordinance as a major first step in implementing green solutions within its own LTCP.

While the Community Panel was the primary method of public involvement in the ordinance process, the ordinance was presented to the general public through presentations to civic groups and during public hearings. The public hearings were established in the summer of 2007, to inform and obtain input from the public regarding the new development and subdivision regulations, and the stream setback and open space and conservation development ordinances. Members of the public voiced their support of the setback ordinance in these hearings.

In 2005, the Wet Weather Program conducted a random sample survey of 14,400 Kansas City households (ETC, 2006). A total of 5,430 surveys were completed. Results of the survey indicated that 77 percent of respondents place a “high” to “very high priority” on maintaining and protecting streams (see Figure 6); 92 percent of the respondents value natural resources; 77 percent believe the water quality of the streams affects property values; and 87 percent said they would be “somewhat supportive” to “very supportive” with the overwhelming majority (70 percent) of that number stating that they would be “very supportive” of KCMO adopting a setback ordinance (see Figure 6). Additionally, 71 percent value water resources for wildlife and 51 percent value water resources for aquatic life.

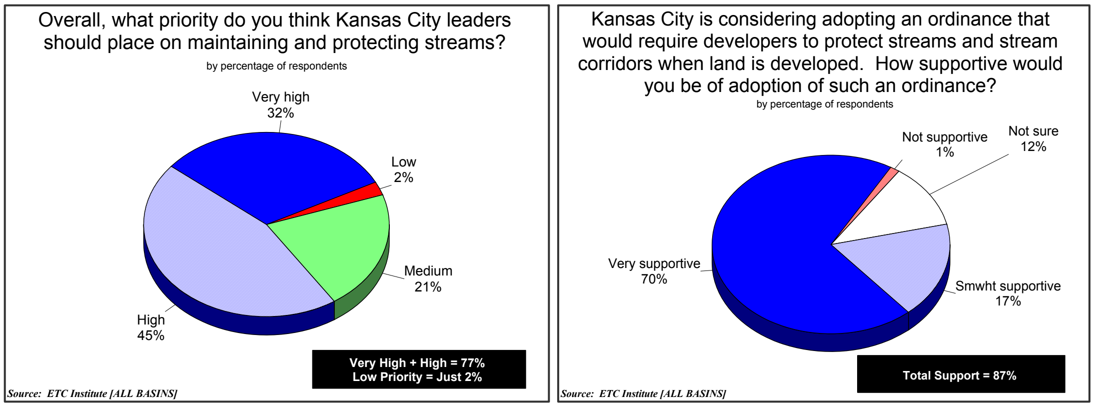

Figure 6. Respondents place a high value on maintaining and protecting streams and adoption of a stream setback ordinance (ETC, 2006).

The results of the survey proved to the Wet Weather Community Panel that the public was indeed in favor of KCMO taking steps to protect water quality and other factors related to riparian and stream ecosystems within city limits. The Wet Weather Community Panel used this survey to substantiate their support of the adoption of the stream setback ordinance.

Public involvement as illustrated through the Wet Weather Community Panel membership, surveys, presentations to civic groups, and public hearings was critical to the development and adoption of the stream setback ordinance. While playing a critical role in the development of the ordinance, if public involvement had been limited to that of the development community, it may have resulted in a very different outcome for the final ordinance.

Summary

A wealth of scientific research into riparian buffer widths, vegetation, and functions formed the foundation for development of the buffer guidance utilized by KCMO. Key model ordinances developed by EPA (1995), Wenger and Fowler (Georgia, 2000), and the CRWP (2006) provided valuable reviews of past research and guidelines for minimum buffers that proved invaluable in developing the criteria for the KCMO setback ordinance (Table 3).

		EPA	Georgia	CRWP	KCMO
Base Factors	Science Based	Yes	Yes	Yes	Yes
	Mapped Streams	USGS topo map	2nd Order and Higher	USGS topo map	KC Natural Resource map
	Buffer Zones	3	1	1	3
	Minimum Width (ft.)	100	100	25	100
Expansion Factors	100-yr Floodplain	X		X	X
	Wetlands	X (or Critical Areas)		X	X
	Steep Slopes	X		X	X
	Vegetation			X	X
	Other	Stream Order, Water pollution hazards	Large and small water supply watersheds	Riparian area contiguity	Conservation Development

Table 3. Elements of the KCMO ordinance compared with the three model ordinances.

Development and adoption of the KCMO Stream Setback Ordinance was a lengthy and involved process that would not have resulted in the final ordinance without the input of national and local knowledge and the collaboration of so many different stakeholders. This lengthy and involved process illustrated the desire of the community as a whole to protect valuable water resources and the importance of gaining political support to achieve this goal. The results of this process are summarized in Table 4.

	Criteria	KCMO Ordinance
Integration of Science	Stream or Natural Resource Assessment	MARC NRI and 35 Watershed Assessments
	Scientific Research/Model Ordinances	Scientific literature and modl ordinances (EPA (1995), Georgia (2000), CRWP (2006)) basis of guidance for buffer widths recommended within the ordinance
	Water Quality Functions	Streamside and Middle Zones
Competing Goals	Flood Control	No future development in floodplain (Middle Zone)
	Protect Infrastructure	Infrastructure must be outside of Streamside Zone
	Water Quality Improvements	Minimum 100 foot buffer with riparian forest vegetation in most or all zones
	Soil Conservation	No development within Streamside or Middle Zones
	Stormwater Management	Outer Zone acts as a BMP (filter strip) to filter sediment and infiltrate water
	Riparian Area Contiguity and Connectivity	Riparian forest vegetation in Outer Zone must be contiguous to Middle Zone with minimum width of 25 feet
	Wildlife Habitat Terrestrial	Riparian forest vegetation provides habitat for variety of wildlife species, connectivity provides travel corridors
	Wildlife Habitat Aquatic	Forest vegetation provides shade and organic debris which contribute to greater stream health for aquatic invertebrates
	Recreational Amenities	Riparian corridors provide greenways and trails
	Developable Land	96% of land retained for development
Public Process	Public Involvement	Wet Weather Community Panel support through resolution, public support voiced during Development Code Hearings
	Community Survey	77% high priority to protect streams; 92% value natural resources; 87% supportive of ordinance

Table 4. KCMO ordinance process was an integration of science, competing goals and public involvement within the ordinance development and adoption process.

The following chapter will discuss how the study of this ordinance does provide a model for use by other communities looking to develop a similar ordinance for resource and water quality protection. It will also illustrate how this ordinance contributes to and expands upon previous model ordinances developed by the EPA (1995), Wenger and Fowler (2001), and the CRWP (2006).

Chapter 5 Discussion and Conclusions

> *"To protect and conserve freshwater ecosystems, there is an urgent need to better understand the complex linkages between natural and human elements of the ecosystems; thereby decreasing dependence on human-engineered systems."* (Naiman, et. al., 1995)

Discussion

The primary goals of this study have been to illustrate that the Stream Setback Ordinance for KCMO is a model ordinance; can meet multiple objectives of the community from stormwater management to providing wildlife habitat and recreational amenities; provides a clear example of the successful integration of competing goals and the public process; and has had a minimal impact on the supply of developable land.

Model ordinances for riparian buffers have evolved along with the increasing knowledge base of scientific information related to functionally appropriate buffers. The CRWP (2006) model appears to be the most comprehensive in regard to providing valuable technical assistance to decision-makers. However, the initial setback widths recommended in the ordinance are smaller than would be anticipated given the scientific validation provided for implementing larger minimum buffers. Unlike the EPA (1995) or Wenger and Fowler's (2000) models, the CRWP (2006) model uses watershed size as the base factor for establishing minimum buffer widths. The size of the watershed is not a factor in the KCMO ordinance. The minimum buffer width is 100 feet on each side of the stream (25-foot streamside and 75-foot outer zone). The buffer is then expanded based upon the presence of the 100-year floodplain (or 100-year conveyance), wetlands, steep slopes, and mature riparian vegetation; all of which are factors identified in the CRWP (2006) model technical guidance.

Multiple Objectives

The primary accomplishment of the stream setback ordinance is the prohibition of new development within KCMO's 100-year floodplain. By preventing future development within the floodplain (streamside and middle zones), KCMO has taken a big step toward reducing future flooding and deterioration of infrastructure commonly associated with past development in the floodplain. KCMO spends hundreds of thousands of dollars or more annually on floodplain properties and infrastructure which can be redirected to providing for other critical city services.

Protection of functional riparian forest systems is another major accomplishment of the ordinance. Along with numerous studies on the benefits of riparian buffers, there is a wealth of information illustrating the importance and value of trees within these buffers for water quality and streambank stability. Ordinances established using a set distance may or may not be wide enough to be effective (Lee et al., 2004). By ensuring that these wooded riparian corridors receive greater protection than non-wooded corridors, the buffer created by the ordinance provides for greater water quality protection. These corridors provide additional benefits by protecting and creating both terrestrial and aquatic habitats which are often limited or absent within urban systems. Furthermore, wooded riparian buffers offer enormous recreational opportunities which make them an economic and social asset for residents (Wilson and Carpenter, 1999; Netusil, 2006).

Impacts to developable land from the implementation of the ordinance were of concern to staff and the development community. The general public understands the multipurpose value of streams and riparian areas (ETC, 2005) and is more accepting of agricultural uses over urban development (Wagner, 2008). However, the development community has a vested interest in ordinances or other regulations that may impact future economic opportunity. The ordinance put in place a moratorium on future development within the floodplain resulting in a total of 8 percent of the undeveloped land within the City to be preserved as permanent open space. Retention of 96 percent of the developable land for development and only 4 percent of the land preserved in permanent open space is one measure of the success of the ordinance. The flexibility provided to developers through density bonuses within the conservation development section of the development code is an additional measure of the success these two ordinances have achieved for future development within KCMO.

Successful Integration

Integration of scientific knowledge into the development of the ordinance was critical to achieving a functional buffer that could provide water quality benefits and streambank stability while allowing development to occur. Significant contributions relating to the study of streams and riparian processes validates the use of scientific literature to support local government interests in implementing riparian setback regulations (CRWP, 2006). If this national and local knowledge base did not exist and if the development community had not requested the incorporation of the latest scientific research and buffer recommendations, it is likely that KCMO would have adopted an ordinance that would have defined the buffer as a set distance regardless of any measurable benefits the buffer could provide. Due to this significant scientific literature, the MARC NRI, and the stream asset inventories, the City Council was able to defend its decision when opponents tried to argue against the scientific validity of the ordinance.

Public involvement is one measure of the success of the ordinance adoption process. Diverse community representation on the Wet Weather Community Panel provided valuable community involvement. Panelists were able to provide two-way communication between residents and businesses and KCMO, ensuring that each side listened to concerns and issues while developing solutions. While the development community was brought into the adoption process early to gain their support and their input influenced the final outcome, it did not negate the overriding premise of the ordinance to provide a functional riparian buffer.

Timing of the EPA's approval of KCMO's Long Term Control Plan (LTCP) submittal played a rather interesting role in the adoption process. It is likely, that were it not for the stipulation by the EPA that KCMO take a major step towards implementing green solutions as part of the LTCP, in this case adoption of the stream setback ordinance, KCMO's LTCP would not have been approved. Also, it is likely that the debate with the development community on buffer widths would have continued and there would have been no guarantee that the City Council would have continued to defend the ordinance. One would hope, however, that the public support shown throughout the adoption process would have continued to sway the Council to adopt an ordinance with enough substance to benefit long-term water quality enhancement and protection.

Future Research

More study of resource based ordinance adoption is needed. While there is a proliferation of information available on appropriate buffer widths from an ecological perspective, there is little information pertaining to how and if communities have utilized this information to develop their ordinances. Does science help communities justify to developers the need for the buffer widths and, thus, does it make it more difficult to reduce the width for their own purposes, or do politicians feel more secure knowing there is a scientific justification backing up the ordinance? How is the ordinance dealt with after adoption? Are communities able to enforce the ordinance with the development community and with themselves? What long-term benefits are derived from this type of ordinance? Can this process help communities to develop other natural resource based planning and zoning?

Additionally, there appears to be little information available on the ordinance development and adoption process illustrating the use and/or value of public involvement. Resource managers and communities alike are hesitant to involve the public for a variety of reasons. Yet, case studies of management and community issues that have used an extensive public involvement approach do illustrate the value such an approach can provide. Perhaps if more communities realized the benefits of early and lengthy involvement of the public in the adoption process, they would find the benefits outweigh the challenges. It has been shown by Wagner (2008), MARC and ETC (2005) and others that the public is well aware of the multiple benefits of streams and riparian areas. Therefore, effectively integrating the public into the decision-making process is likely to determine the effectiveness of future resource planning and management (Dwyer et al, 2000).

Another step for research would be to determine how effective these buffers are once the ordinances are in place. It would be interesting to compare ordinance effectiveness looking at ordinances that protect riparian systems versus those that are simply a set distance. Also, what additional economic and social benefits does the type of buffer provide to the community?

Conclusions

Ecosystem planning and management have been generally applied to rural systems and not urban due to the human component. However, ecologists and other researchers have begun taking a closer look at urban systems and including this major component. By doing so, they are better able to predict the outcomes and gain acceptance for management recommendations and regulations. Watershed planning is one example of ecosystem planning which many communities are adopting to accomplish economic and environmental goals. Both planning efforts require managers and city staff to disregard jurisdictional boundaries when making management recommendations. One reason Kansas City can readily use this type of approach is due to its large geographic size. KCMO encompasses a large geographic area including 35 watersheds and numerous acres of valuable natural resources and developable land. By taking an ecosystem approach to development of the setback ordinance, management decisions can be made at the watershed level instead of jurisdictional boundaries. KCMO can now conserve functional riparian forest buffers which can be used to enhance and improve water quality, and provide habitats for wildlife and recreational opportunities for people, which in turn enhances quality of life within the communities that make up Kansas City.

The adoption of the Stream Setback ordinance will result in numerous benefits for KCMO and the region while providing other communities in the metropolitan region and nationwide a model example of the integrative process. Kansas City is faced with a multi-billion dollar stormwater and combined sewers problem. Stream corridor protection and enhancement was one of 11 policy areas developed through the KC One Program critical to the future success of the city. Thus, implementation of the setback ordinance illustrates that KCMO has taken a major step toward improving water quality and protecting other valuable resources that will require less economic input while providing greater social and environmental benefits.

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Appendix Synopsis of Model Ordinances

EPA Model Stream Buffer Ordinance

This model establishes a three-zone system based on perennial and intermittent streams identified on U.S. Geological Survey (USGS) topographic maps as whole or dotted blue lines respectively. The zones include streamside, middle, and outer for a recommended minimum width of 100 feet. Additional recommendations for expansion of the buffer are based on stream order, percent slope, 100-year floodplain, wetland or critical areas, and water pollution hazards. An emphasis is placed on the use of forest vegetation for the buffer. Vegetation within zones is to be: streamside - undisturbed native vegetation; middle zone - mature native vegetation; and outer zone – native vegetation is encouraged. The model provides permitted and prohibited uses for each zone, plan requirements, management and maintenance, enforcement, and waivers. While the model is relatively easy to interpret for the baseline and expansion factors, the slope tables add a level of complexity to the ordinance.

Georgia Model Local Riparian Buffer Ordinance

The model proposed by Wenger and Fowler (2000) for communities in Georgia is a Riparian Buffer District Overlay Zone. As with the EPA model, the model is based on perennial and intermittent stream types identified on USGS topographic maps. While the minimum recommended distance is 100 feet, the buffer in this model is a single zone, fixed or averaged width buffer. The model does not provide for expansion factors, but does provide prohibited uses, exceptions, and minor and major variances. The model meets minimum standards under the state's riparian buffer provisions for water supply watershed protection. In addition to riparian buffer requirements, the standards place other restrictions on large and small water supply watersheds.

CRWP Model Riparian Setback Ordinance

The CRWP has developed the most current model ordinance for riparian setbacks along with technical information to assist local decision-makers in developing a similar ordinance. The ordinance doesn't define streams by type or by order. Minimum buffers change as streams get larger (i.e., the size of the watershed increases) and wetland category/class increases. Wetlands, defined in accordance with the 1978 U.S. Army Corps of Engineers Wetland Delineation Manual, "are those areas that are inundated or saturated by surface or ground water at a frequency and duration that are sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions". Wetland categories range from lowest (class 1) to highest (class 3). Category one wetlands are minimally supporting of wildlife habitat, hydrology and recreational function; have low species diversity; and may have some potential for restoration to category two wetlands. Category two wetlands support moderate wildlife habitat, hydrology and recreational functions; are dominated by native species; and have a reasonable potential for reestablishment of lost wetland functions. Category three wetlands have superior wildlife habitat, hydrological and recreational function; have high levels of species diversity; and consist of high quality mature forested wetlands, vernal pools that are scarce at a regional and/or statewide level. The model uses single zone buffers on each side of the stream that begin at 25 feet for streams in watersheds less than 0.5 square miles (320 acres) and increase up to 300 feet for streams in watersheds larger than 300 square miles (192,000 acres). Factors for consideration when adopting a setback regulation include: minimum widths;

expansion of minimum setback widths that include floodplains, wetlands, and steep slopes; riparian area contiguity; types of vegetation; permitted and prohibited activities; and long-term management.